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A NEW CONTACTLESS TACHOMETER

Electronic

V. A. KONSTANTINOV, Engineer

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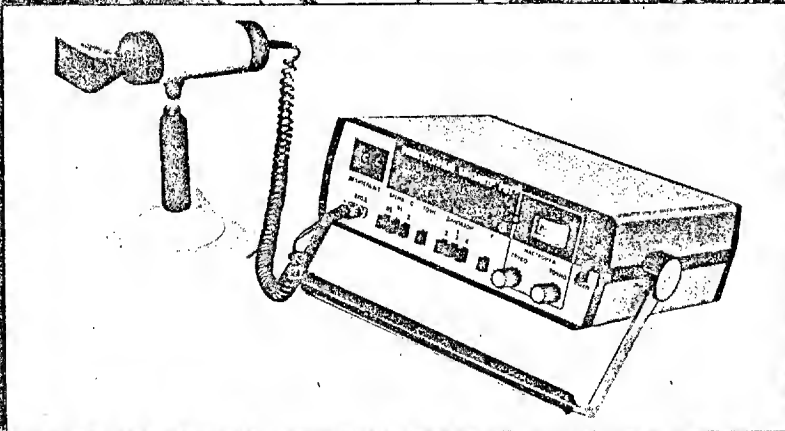
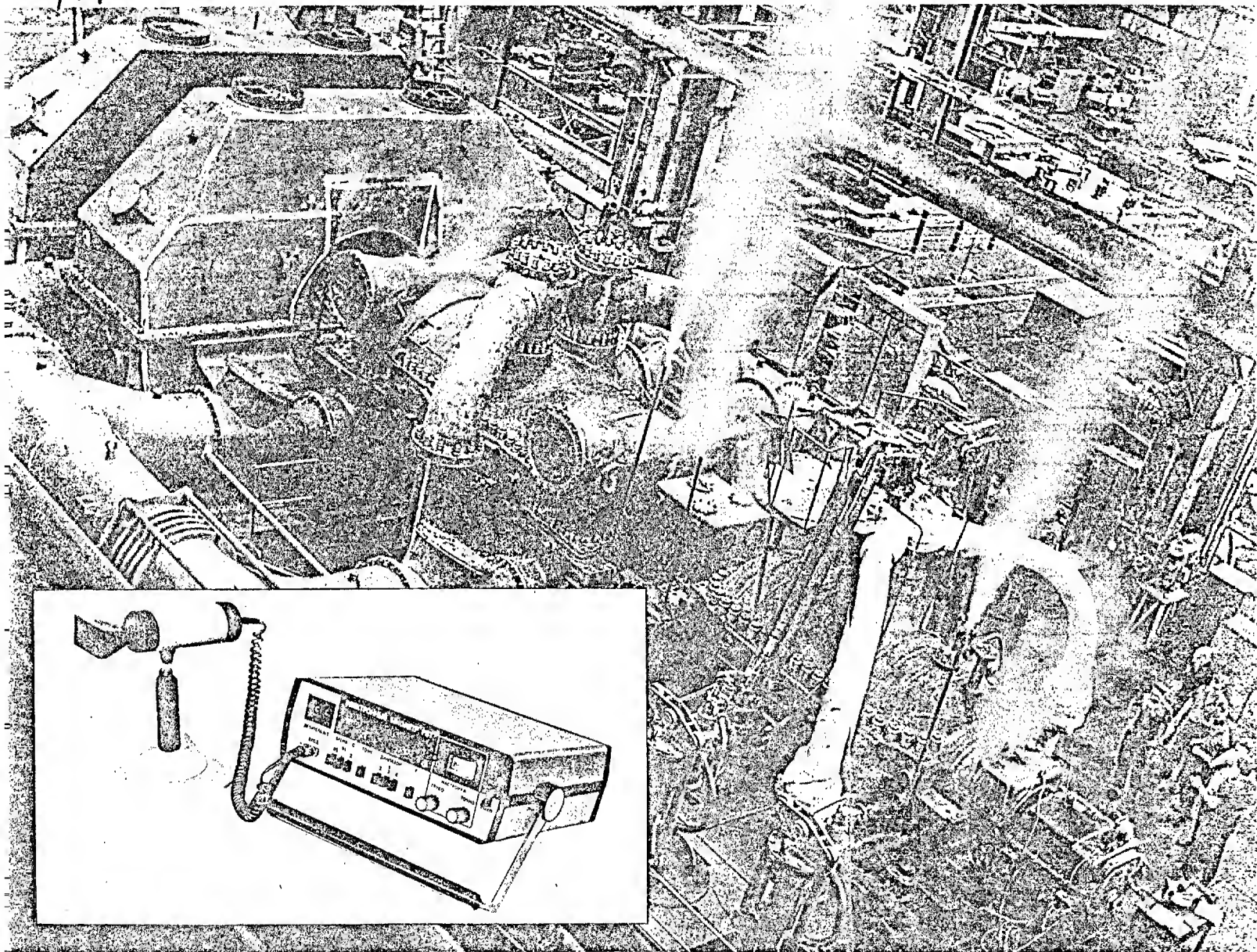
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The instrument in question — the RVT electronic tachometer — is a radiowave measuring instrument connected with the object through the microwave-band electromagnetic field.

important, spreads over the machines' natural waveguiding elements such as the engine exhaust pipe to the turbosupercharger rotor, to the valves, etc.

All this gives the RVT instrument considerable advantages over stroboscopes.

operator reduces the instrument's reading to ordinary units of measurement. If rotational speed fluctuates more than three times per second, the automatic speed change tracking system goes on.

Radio Methods More Convenient Than Stroboscopic Ones

The RVT radiowave tachometer measures the rotational parameters of various machine parts from any distances, practically in any requisite frequency range, no matter what materials these parts are made of, and irrespective of their shape and size. Electromagnetic energy passes through dielectric walls and, what's no less

Adequate Accuracy

The radiotachometer measures rotational speed with an accuracy to within $\pm 0.017 \text{ s}^{-1}$. If the rotor carries an impeller or a pinion, measurement accuracy can be increased K times, where K is the number of blades or teeth. All it takes is a no less than 3-mm blade or tooth pitch.

By dialling the number (from 1 to 99) equal to that of blades, teeth and other such elements of a rotating object, the

Many Uses

The radiowave principle of measurement extends the range of the RVT tachometer application considerably. It is suitable for measuring surface vibrations accurately within 0.1 Hz, as well as running speed cars, for instance, from as far as 600 away.

Combined with an oscillograph or with recorder, the RVT instrument can be used for measuring relative amplitudes and phases of various objects' surface

BASIC SPECIFICATIONS OF THE RVT RADIOTACHOMETER

Measurement ranges: rotational speed, s ⁻¹ 1·10 — 1,6·10 ⁴ vibration, Hz..... 1·10 — 2·10 ⁵				
	Measurement ranges			
	Rotational speed, s ⁻¹			Vibration frequency, Hz
	1·10 ¹ —1,6·10 ²	1,6·10 ² —1,6·10 ³	1,6·10 ³ —1,6·10 ⁴	1·10 ¹ —2·10 ⁵
Error: s ⁻¹ Hz.....	±0.017 —	±0.17 —	±1.7 —	— ±0.1
Minimal measure- ment time, s.....	0.3	0.5	3.0	—
Automatic frequency change speed tracking range, %..... from +300 to —70				
Maximum distance to object, m..... 10				
Linear movement speed measurement: speed, km/h..... 20—200 error, %..... ±1				
Power consumption, W..... 36				
Supply voltage, V: a.c. (50 or 400 Hz)..... 220 d.c..... 12 or 24				
Mass, kg..... 4				

orations, as well as for periodic structure integrity checks. Such checks can reveal a broken pinion tooth or a mechanical flaw in a turbocompressor rotor blade, for instance.

The RVT Succeeds
Where Stroboscopic and
Induction
Tachometers Fail

A typical application of the RVT radiotachometer is measuring the rotational speed of the IC-engine's supercharger compressor. This is a very important job as any deviation of the turbosupercharger's work from normal impairs the technical and economic indices of the engines. Such measurements are essential to the development and operation of aircraft engines, centrifuges, turbines of various kinds, electric motors (low-power ones, in particular), gyroscopes, etc.

The RVT radiotachometer cuts down to a third or even a fifth the time it takes to measure the rotational speed of the basic elements of an internal combustion engine, for instance. Measurement speed is 10 to 20 times higher as compared with the stroboscopic method. The RVT radio-ta-

chometer measures the r.p.m. of the centrifugal oil cleaner rotor in 6—8 sec, and of the turbocompressor rotor, in 10—15 sec.

A New Circuit
for Measuring
the Reflected Signal
Modulation Spectrum

In measuring turbocompressor rotor r.p.m., a typical reflected signal modulation spectrum contains, apart from the fundamental harmonic the frequency of which equals the rotor rotational speed, a number of harmonics with different frequencies — components connected with the operation of the turbine, with valve and engine piston movements. The amplitude distribution of the harmonics depends, in general, on the incidence angle of the microwave signal, on the distance of its travel, on the shape of the object, and other factors. Sometimes a reflected signal is superimposed by modulations caused by the movement of several components, although only one component's rotational speed is to be measured.

The way out was offered by a transceiving aerial whose designing and right positioning relative to the rotating object involved a number of technical problems. We

have devised a method of filtering the reflected signal modulation spectrum, of finding the requisite harmonic and of tracking it automatically.

Measurement results are brought out to a four-digit indicator. An output to an analogue recorder is provided. As a result, the instrument can be used for automatic control of most various objects' rotational speed change dynamics.

The use of standard microcircuits and opto-isolators has simplified the instrument to a maximum.

No special skills are required for operating an RVT tachometer.

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T SPEEDS F UP TO FIVE METERS PER SECOND

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le new
ectromagnetoacoustical
(MA) thickness gauges are
ee from the shortcomings
the priorart gauges. The
/A instruments are
ontactless, they measure
e thickness of rolled stock
any travel speed with a
gh accuracy and have a
mber of other important
lvantages.

The new method consists, essentially, in
xciting an ultrasonic oscillation pulse in
e metal article being rolled. The thickness
the article is judged by the time it takes
e pulse to pass through it, bounce off the
posite surface and return to the sensor
s a reflected signal.

Measurements Contactless

The ultrasonic pulse is excited by means
f a pulsed electromagnetic field lasting for
out 0.5 μ sec. The pulse oscillator induc-
or is in a permanent magnetic field which
ermeates the article under test. Eddy cur-
ents induced by the pulsed electromagne-
c field interact with the permanent mag-
etic field and thus excite an ultrasonic
ave inside the material being tested. The
ave extends in depth, reaches the oppo-
ite surface and comes back causing vi-
brations on the surface which generated this
ulse. The vibrating metal in the permanent
magnetic field excites eddy currents which
re picked up by the inductor now playing
he role of a sensor.

As we see, the ultrasonic pulse is in-
luced, and the bounced-off signal picked
up, without any contact with the article
under test.

High Measurement Speed and Accuracy

Pulse repetition frequency is high
enough — about 100 Hz. Therefore,
measurements can be made at a rolled
stock travel speed of up to 5 m/sec. The
basic error does not exceed 2% over the
thickness range of 3 to 15 mm, with scale
linearity guaranteed.

High Level of Interference Suppression

If the distance between the surface of
the article under test and the inductor/sen-
sor changes, that has no effect at all on the
accuracy of the EMA instrument's oper-
ation. This is an important advantage of the
new thickness gauge over the ordinary
magnetic and electromagnetic thickness
gauges.

The neutralisation principle is used to
prevent the EMA instrument from reacting to
any chance defects of the surface: the
"fault" signal is given only in case the rolled
stock thickness is indicated to deviate from
normal for five times at a stretch.

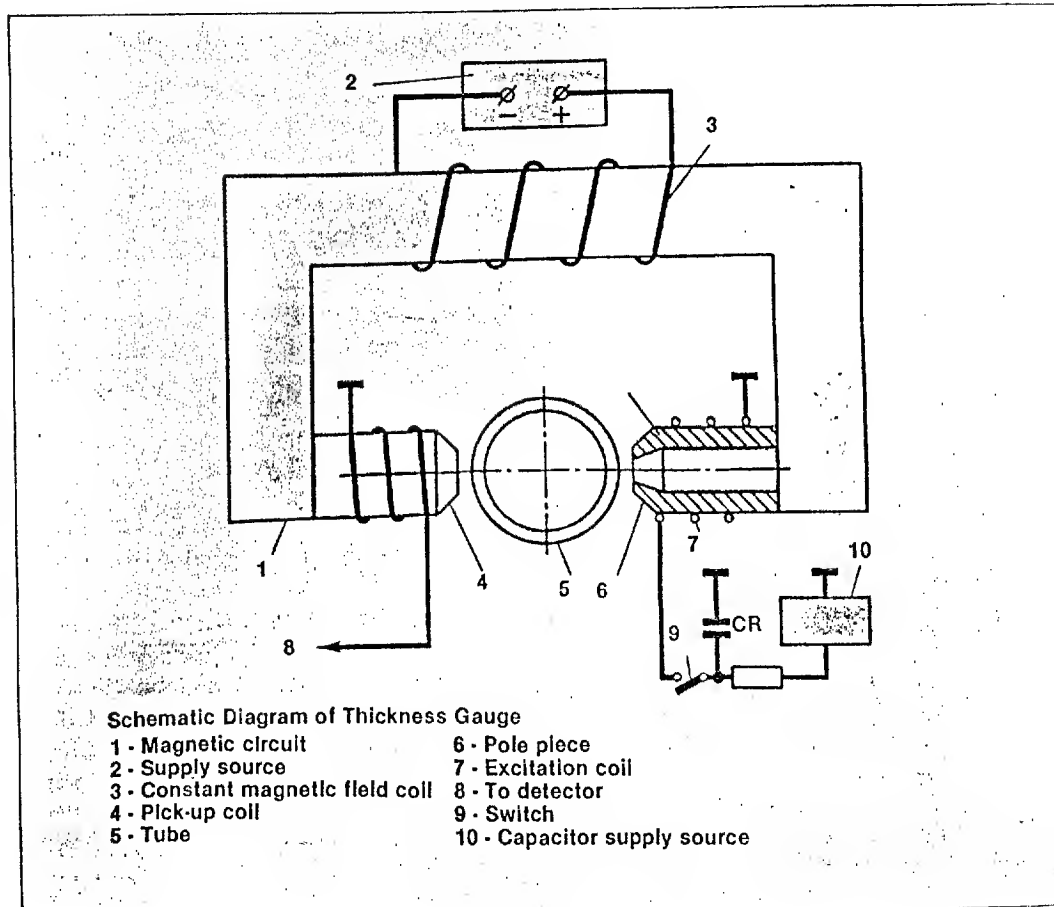
Finally, the instrument's circuit provides
for suppressing the interference concomi-
tant to acoustical wave propagation in
metal.

No matter how curved the surface of the
article under test may be, this causes no
measurement error. As a result, the new
instrument is best suitable for testing pipe
walls as well as sheet metal thickness.

Rolling Mill Operators' Work Made Easier

The EMA thickness gauge gives accu-
rate indications of positive and negative
deviations of the rolled stock thickness
from normal. The deviation limits are set
from the instrument's control panel. The
EMA thickness gauge can be fitted into the
rolling mill stand control loop to make the
operator's work easier. The EMA instru-
ment can be connected with an automatic
device indicating, in one way or other, any
faults in the rolled stock.

The new instrument has been patented
in the USA, the FRG, Japan and France.



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FOURTEEN NEW FLAW DETECTORS

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The VD Flaw Detectors for Checking Quantity-Produced Articles

These instruments check wire, pipes, round billets, round and hexahedral rods from 0.05 to 200 mm in diameter, and square billets from 50×50 to 250×250 mm in cross section for surface defects by the eddy current method. A distinctive feature of this method is that it brings equally accurate results for ferrous and non-ferrous metals. The article under test is put either through a ring on which transducers rotate, or through a stationary transducer.

As compared with the prior-art flaw detectors with rotating transducers, the instruments of the VD series are more reliable, simpler in design and take less time to maintain. Testing pipes and rods with a curvature of up

to 5 mm per one meter of length is no problem at all. Variations in the clearance between the transducer and the surface under test within ±2 mm have no effect on the flaw detector's sensitivity, as distinct from the prior-art models. Hence the possibility to test oval-shaped as well as round articles.

The VD-40N, VD-41N, VD-43N and VD-60N flaw detectors are fitted with a facility pinpointing the flaws in the rolled articles under test. They provide for sorting the articles into three categories: "OK", "Reclaimable spoilage", "Reject".

The VD-30P flaw detector can by right be described as universal. It gives invariably accurate indications over a wide range of diameters, configurations and metal grades thanks to its easy-to-detach in-

terchangeable transducer with the appropriate diameter of the through hole and to special filters. Indications are delivered to counters, a rapid automatic recorder and a computer.

The VD-10P and VD-20P flaw detectors test wire of any material with electrical conductivity ranging from 60 Mohm/m. The result analysis unit indicates the length of the inadequate sections and their location in the wire coil. The same information is delivered to a printer and to the program unit which controls the grade assembly of the automatic machine making various grades out of tested wire.

The design of these flaw detectors' transducers merits special mention. Usually transducers intended for t

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The instruments which detect flaws in ferrous and non-ferrous metal articles by the eddy current or constant magnetic field method keep improving. In this article we dwell on new flaw detectors using these methods. Many of these instruments have no parallels in world practice, and others are much simpler and more reliable than the prior-art ones. They offer new ways of checking for higher product quality.

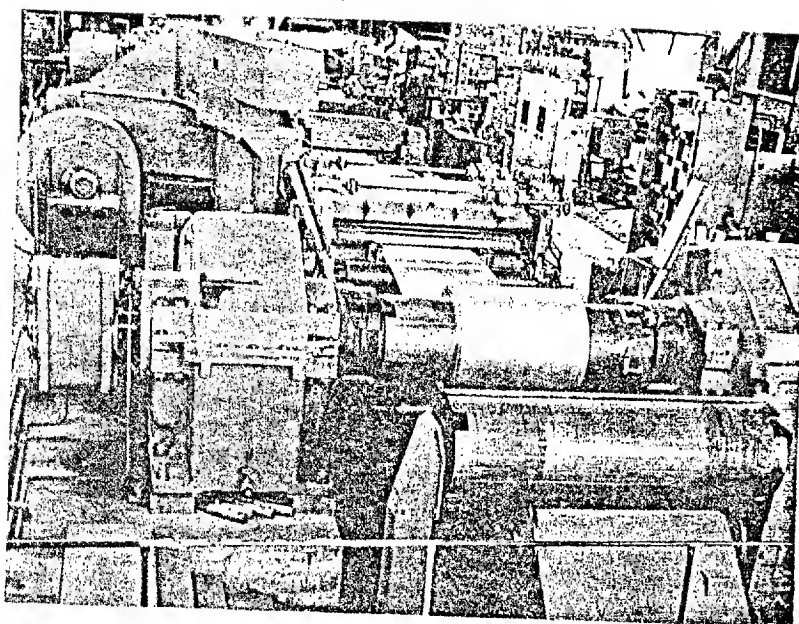
BASIC SPECIFICATIONS OF THE VD-SERIES FLAW DETECTORS

Detector model	VD-10P	VD-20P	VD-30P	VD-40N	VD-41N	VD-43N	VD-60N
Transducer type	Stationary			Rotary			
Object configuration	round	round	round annular hexahedral	round or annular			square
Diameter, side length, mm	0,05—0,2	0,2—0,6	1—47	30—120	10—50	100—200	50—250
Minimum size of flaw detected, in depth: mm	—	—	—		0.2-0.5**		0.5***
% of diameter	10	10	1-2*				
Maximum object travel speed, m/s	5.0	5.0	3.0		1.5		1.0

* depending on diameter;

** less for sized articles, more for hot-rolled articles;*** Including those on edges.

Stationary flaw detectors have proved efficient means of rolled stock testing (1). Portable flaw detectors are very convenient for testing various items on the workbench, during the assembly and mounting of large-size pipes and constructions (2).

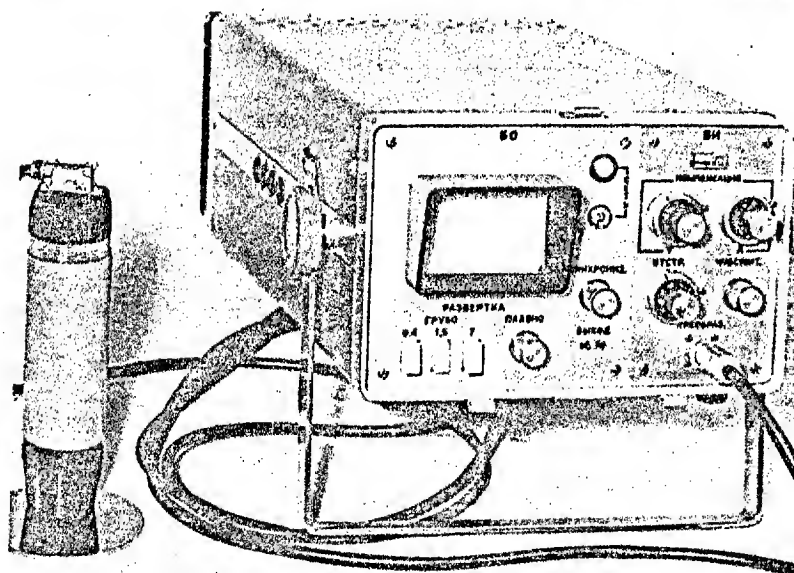


ting thin wire are made by hand. The new transducers do not require handwound coils and are much longer lasting than the prior-art ones.

The MD Flaw Detectors for Testing Steel Sheets and Pipes

In many cases the eddy current method proves less effective than that of constant magnetic field. This is true of testing thick rolled sheets and pipes when inner as well as surface flaws are to be detected. Such sheets and pipes can best be tested, at the rate of their manufacture, with the MD flaw detectors depending on constant magnetic field for their operation.

The MD-10F flaw detector comes complete with devices for magnetizing a pipe perpendicular to its axis (circularly) and for rotating transducers around a pipe. An electronic system processes the signals coming in from the transducers and delivers commands to the sorting mechanism, with data on the outer and inner flaws of the pipes arriving separately. The MD-10F flaw detector has a self-checking unit which signals any mechanical failure and any disturbance of control settings.



BASIC SPECIFICATIONS OF THE MD-SERIES FLAW DETECTORS

Detector model	MD-10F	MD-90I	MD-100I
Transducer type.....	Rotary	Rotary and stationary	Stationary
Object under test.....	Pipe	Sheet	Hot-rolled strip with welded joint
Dimensions, mm:			
Outer diameter.....	30—160	—	—
Sheet thickness.....	up to 12	—	—
Strip thickness.....	—	560—2,500	≥ 500
	—	0.4—3.0	1—6
Detectable crack:			
Depth, mm.....	0.2 and over	—	—
Width, % of metal thickness.....	10	7	—
Travel speed, m/s.....	up to 3	0.5—5.0	0.5—10.0

The MD-90I flaw detector is intended for testing rolled sheets in crosswise and lengthwise metal cutting lines. It sorts out good sheets from faulty ones and indicates the location of flaws.

Magnetic field dispersions in the flaw areas are picked up both by stationary transducers and those rotating parallel to the metal sheet. Depending on the rolled stock width there can be one transducer or several of them. A special electronic circuit precludes mistakes connected with changes in clearance between the transducers and the metal article being tested.

The MD-100I welded joint indicator is an instrument

which delivers signals to the automatic system of a continuous steel sheet rolling mill. The information it furnishes about the joint helps adjust rolling speed and prevent metal strip breakage.

The instrument can also be used in continuous pickling lines, automatic weld cut-out machines and other such units.

An important distinguishing feature of the MD-100I indicator is its high noise immunity which precludes the generation of spurious signals. An ingenious layout of the transducers and a new method of information processing make it possible to single out the weld's magnetic field only, "ignoring" single or group flaws. The instrument comes complete with a sheet magnetizing device.

Portable Universal Flaw Detectors for Transport and Heavy Engineering

Surface defects — cracks, hair seams, laps and other defects of ferrous and non-ferrous metals on planes 30 mm and more in diameter are detected quickly and accurately by the VD-20N-D instrument. Fitted out with a rotary transducer and using the eddy current method, it finds flaws from 0.2 mm deep and 10 mm long even on articles with an electrically non-conductive coating up to 1 mm thick. The flaw detector is equipped with a defect indicator lamp. A more accurate information about the surface being tested can be obtained from the screen of a cathode-ray tube. As the transducer is moved over the metal surface by hand, the instrument as a special electronic circuit to preclude spurious signals and misses which might be caused by variations in the clearance between the transducer and the metal being tested.

The MD-40K flaw detector is very convenient for **checking**

the quality of coarse threads of steel components like studs, rods, bolts and hooks. The instrument is fitted with a set of transducers which make it possible to check on threads 30 mm and over (pitch from 1.5 to 12 mm). The instrument detects flaws more than 0.5 mm deep and over 10 mm long. The transducer is moved consecutively along the thread fillets for the purpose. The procedure can be easily mechanized, if necessary.

The MD-41K flaw detector reveals **fatigue cracks in gear transmissions with pitches of 4.5 to 8** made of ferromagnetic materials. This instrument, with its electronic circuit similar to that of the MD-40K, comes complete with a set of transducers for checking gears over the entire above-mentioned range of pitches. A transducer is placed in a gear tooth space by hand. An advantage of this instrument is that with it gear wheels can be tested without the gear transmission being taken apart because there is no need for any special preparation of the articles under test. The instrument detects flaws more than 2 mm deep and over 10 mm long.

The magnetographic method of testing welded joints in pipelines up to 1,420 mm in diameter, with pipe walls up to 20 mm thick is more convenient — and much safer for the servicing personnel — than the radiographic one. The magnetographic method consists in placing a piece of ordinary ferromagnetic tape 35 or 50.8 mm wide on a joint and recording the flaws' magnetic field on it by passing a permanent magnet along the joint.

The new UV-30G flaw detector reads the information recorded on tape — the leakage fields of the weld's flaws — and reproduces it on the screen of the cathode-ray tube. Besides, test results are recorded on paper tape. This method of testing is 5-7 times more efficient than the X-ray or radioisotopic ones.

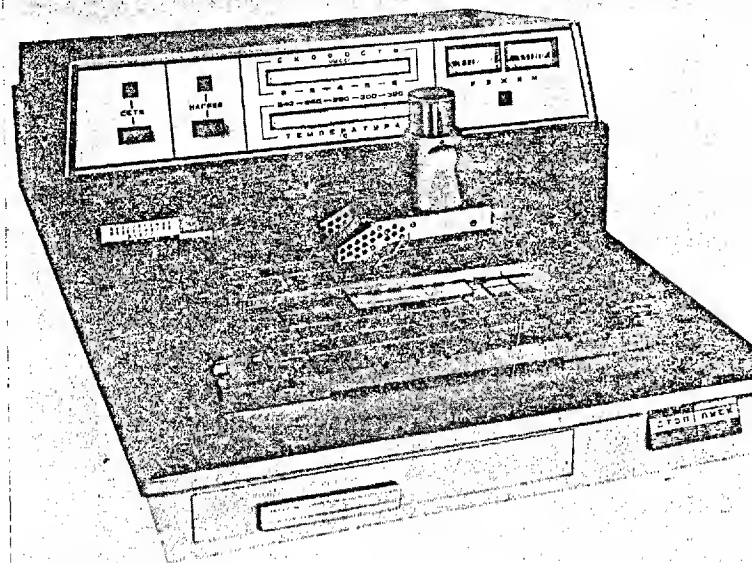
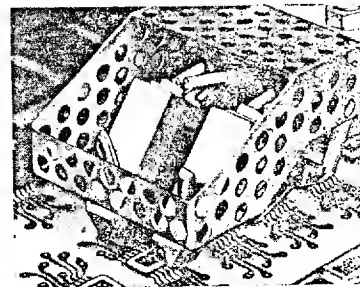
UP TO A THOUSAND INTEGRATED CIRCUITS PER HOUR

A new semi-automatic soldering device is 3 to 10 times more efficient than conventional equipment.

Add to this the excellent quality of soldered joints, the optimum conditions of solder melting, extraordinary soldering efficiency (it takes a mere 0.3 sec to solder one lead), the absence of solder "jumpers" between leads, the light weight and compact size.

Another merit of the device is a simple and efficient facility to prepare microcircuits for assembly. It bends microcircuit leads, trims them to size and

applies precisely dosed amounts of solder to their ends — all in one working stroke! The semi-automatic soldering device and the integrated circuit preparation facility have been patented in the USA, the FRG, Great Britain, France, Japan and other countries.



BASIC SPECIFICATIONS OF THE SEMI-AUTOMATIC DEVICE FOR SOLDERING INTEGRATED CIRCUITS AND FACILITIES FOR PREPARING THEM

Semi-automatic device:	
Efficiency, integrated circuits per hour.....	up to 1,000
Soldering temperature, 0° C.....	about 300
Temperature maintenance accuracy, 0° C.....	± 5
Maximum printed card size, mm.....	210 × 280
Overall dimensions of the semi-automatic soldering device, mm..	400 × 500 × 220
Mass, kg.....	17
Power consumption, W.....	150
Integrated circuit preparation facility:	
Press effort, N.....	700
Rod stroke, mm.....	20
Solder wire diameter, mm.....	0.3—0.6
Overall dimensions of facility, mm.....	150 × 60 × 100
Mass, kg.....	2

NEW ULTRASONIC INSTRUMENTS FOR OBSTETRICS

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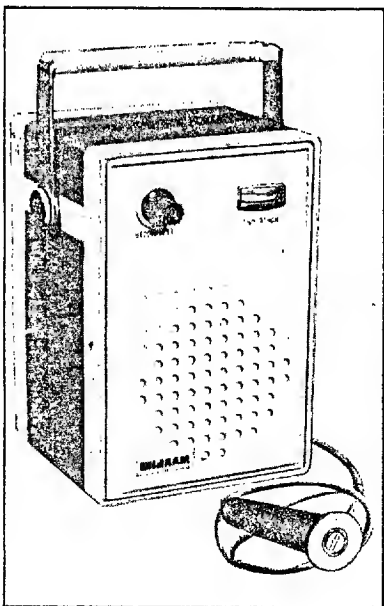
Left — the Malysh portable instrument; right — the Ekran stationary tomograph with two display units (screen sizes: 23 and 50 cm in diagonal).

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early diagnosis problem
ed by various methods,
trasonic method (UZ) be-
rtainly the most suitable
or use in obstetrics and
cology.

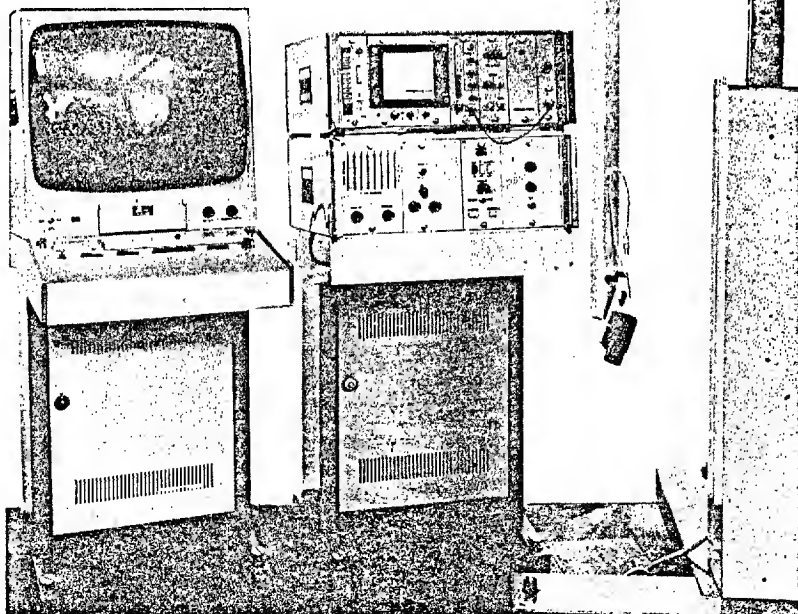
ew instrument, Malysh
(DM), has been devel-
specially for obstetri-
Its ultrasonic converter
continuous ultrasonic
tions to the patient's
rough a layer of contact
The signals, reflected
internal structures, are
up by the converter, with
quency of the oscillations
ed from moving struc-
(the heart, blood vessel
etc.) differing from that of
cillations reflected from
ary structures (the Dop-
ect). As distinct from the
scopic methods, the ul-
c converter is not affec-
usual acoustic noises in
se.

design of the amplfier
etector of the Doppler
ncy signal ensures the
noise ratio necessary for



sending minimum-power ultra-
sonic signals to the patient's
body. Radiation intensity does
not exceed 10 MW/cm², which
totally precludes any harmful
effects on the foetus.

The Malysh can be used for
diagnosing palpitation and
cardiac disorders in the foetus
and for localizing the placenta.
Palpitation is detected as early
as in the 8th-10th week of
pregnancy. Thanks to the con-
verter fitted with focussing len-
ses of a special design, the lo-
cality of the moving structure
control has been sharpened,
and their differentiation im-
proved. In these character-



istics, the Malysh is superior to
the prior-art instruments of its
kind.

The Ekran (UI-20EM) pulse
ultrasonic tomograph is of a
still wider diagnostic lati-
tude. It shows sectional roent-
genograms of internal organs
on a display unit screen.

Upon being processed, the
echo signal proceeds to the
memory unit where an image is
formed by scanning. A vidicon
is used as a memory cell; in-
formation about the converter's
co-ordinates and the reflected
pulse amplitude is delivered to
the intermediate picture tube.
The final signal shaped on the
vidicon target appears on the
videomonitor screen as a half-
tone image. This mode of to-
mograph operation is usually
referred to as the "B" mode.

Besides, the image can be
formed in the "A" and "M"
modes.

In the former mode, the sig-
nal is formed on the screen only
along the line scanned by the
ultrasonic converter at the
moment. On the horizontal, the
visual display unit screen
shows the value of the echo
pulse, and on the vertical — the
distance inside the body from
the converter's point of contact

with the skin. This method is
commonly used in encephalo-
graphy to study brain struc-
tures.

What the "M" and "A" modes
have in common is the immobi-
lity of the converter. The differ-
ence between the modes is that
in the "M" mode the echo am-
plitude shows as bright lumi-
nance in the appropriate point
of the screen, and the ampli-
tude of this or that structure's
movement — as a "hump" ris-
ing over the scan trace. This
mode is used chiefly in cardiol-
ogy for examining heart valves
and walls.

Two visual display units with
23 and 50 cm screens (diag.)
broaden the sphere of the Ek-
ran device's application con-
siderably. In particular, it is
used for diagnosing kidney, liv-
er and other troubles, localizing
stones, tumours and inflam-
mations. It enables oncologists
to determine the size and posi-
tion of metastases more con-
fidently.

A distinguishing feature of
the Ekran device is its conver-
ter of a new design which en-
sures high pulse resolution of
the device.

BASIC SPECIFICATIONS OF DEVICES FOR
ULTRASONIC MEDICAL INVESTIGATIONS

	Malych	Ekran
area under examination, mm.	Any	400 × 300
l resolution, mm:		
depth.....		2,5
ontal.....		4,0
ing frequency, MHz.....	3,0	2,5
storage time, mln	—	15
consumption, W.....	1,5	500
supply.....	From batteries	From 220 V mains
g.....	3	250